

Notice of Allowability

Application No.

09/882,840

Examiner

Jason M. Perilla

Applicant(s)

BAUM ET AL.

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2634

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the amendment filed February 1, 2005.
2. ☒ The allowed claim(s) is/are 1-3, 5-26, and 28-48 renumbered respectively as claims 1-46.
3. ☒ The drawings filed on 15 June 2001 are accepted by the Examiner.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☐ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
 6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- | | |
|---|--|
| 1. <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 5. <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 2. <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 6. <input checked="" type="checkbox"/> Interview Summary (PTO-413),
Paper No./Mail Date <u>20050511</u> . |
| 3. <input type="checkbox"/> Information Disclosure Statements (PTO-1449 or PTO/SB/08),
Paper No./Mail Date _____ | 7. <input checked="" type="checkbox"/> Examiner's Amendment/Comment |
| 4. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit
of Biological Material | 8. <input checked="" type="checkbox"/> Examiner's Statement of Reasons for Allowance |
| | 9. <input type="checkbox"/> Other _____. |

EXAMINER'S AMENDMENT

1. Claims 1-3, 5-26, and 28-48 are pending in the instant application.
2. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Kenneth A. Haas (42614) on May 11, 2005.

The application has been amended as follows wherein the following versions of claims 1, 5, 10, 11, 15, 16, 22, 23, 25, 31, 32, 34, 36, 40, 41, and 47 are replaced in their entirety:

- 1 A method comprising the steps of:

receiving a single orthogonal frequency division multiplexed (OFDM) symbol that exhibits $1/N$ symbol symmetry, where N is an integer greater than or equal to 2;

determining a timing synchronization ~~from~~ of the single OFDM symbol by applying a correlation metric to the single OFDM symbol; and

determining from the single OFDM symbol an integer subcarrier frequency offset ~~from~~ of the single OFDM symbol.

5. The method of claim 1, wherein the step of determining the integer subcarrier frequency offset comprises the step of applying a differential correlation to a frequency-shifted version of the single OFDM symbol.
10. The method of claim 1, wherein the step of determining the timing synchronization comprises the step of utilizing the correlation metric to update a previously determined timing synchronization.

11. The method of claim 1, wherein the single OFDM symbol is an OFDM synchronization (sync) symbol.

15. A method comprising the steps of:

receiving a single orthogonal frequency division multiplexed (OFDM) symbol;

determining from the single OFDM symbol a timing synchronization ~~from~~ of the OFDM symbol;

determining from the single OFDM symbol a fractional subcarrier frequency offset ~~from~~ of the single OFDM symbol;

removing the fractional subcarrier frequency offset from the single OFDM symbol;

determining from the single OFDM symbol an integer subcarrier frequency offset ~~from~~ of the single OFDM symbol.

16. The method of claim 15, wherein the step of determining the integer subcarrier frequency offset comprises the step of applying a differential correlation to a frequency-shifted version of the single OFDM symbol.

22. The method of claim 15, further comprising the step of performing a ~~fourier~~ Fourier transform on the single OFDM symbol prior to determining the integer subcarrier frequency offset.

23. The method of claim 15, wherein the single OFDM symbol is an OFDM synchronization (sync) symbol.

25. An apparatus comprising:

a timing synchronizer, arranged and constructed to obtain, from the single OFDM symbol, a timing synchronization ~~on~~ of a single orthogonal frequency division multiplexed (OFDM) symbol;

a fractional subcarrier frequency synchronizer, operably coupled to the timing synchronizer, wherein the fractional subcarrier frequency synchronizer is arranged and

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constructed to obtain, from the single OFDM symbol, fractional subcarrier frequency synchronization ~~on~~ of the single OFDM symbol; and

an integer subcarrier frequency synchronizer, operably coupled to the fractional subcarrier frequency synchronizer, wherein the integer subcarrier frequency synchronizer is arranged and constructed to obtain, from the single OFDM symbol, integer subcarrier frequency synchronization ~~on~~ of the single OFDM symbol.

31. The apparatus of claim 25, further comprising a ~~fourier~~ Fourier transformer that converts the single OFDM symbol to a frequency domain signal.

32. The apparatus of claim 25, wherein the single OFDM symbol is an OFDM synchronization (sync) ~~sync~~ baud.

34. A method comprising the steps of:

receiving a single orthogonal frequency division multiplexed (OFDM) symbol;

determining an integer subcarrier frequency offset ~~from~~ of the single OFDM symbol by applying a differential correlation metric to the OFDM symbol

removing a fractional subcarrier frequency offset ~~from~~ of the single OFDM symbol determined from the single OFDM symbol prior to the determining step.

36. The method of claim 34, wherein the step of determining the integer subcarrier frequency offset comprises the step of applying the differential correlation metric to a frequency-shifted version of the single OFDM symbol and a known OFDM synchronization (sync) ~~sync~~ baud.

40. The method of claim 34, wherein the integer subcarrier frequency offset, γ_2 , is computed using the following formula

$$\gamma_2 = \Delta f \cdot s_{rem} \text{ where } s_{rem} = \arg \max_s |R(s)|,$$

where Δf is subcarrier spacing, s is an instantaneous subcarrier shift being considered and $|R(s)|$ is the magnitude of the differential correlation metric.

41. A method comprising the steps of:

receiving a single orthogonal frequency division multiplexed (OFDM) symbol that exhibits $1/N$ symbol symmetry, where N is an integer greater than or equal to 2;

determining from the single OFDM symbol a subcarrier rotation ~~from~~ of the single OFDM symbol,

determining from the single OFDM symbol an integer subcarrier frequency offset ~~from~~ of the single OFDM symbol.

47. The method of claim 41, wherein the single OFDM symbol is an OFDM synchronization (sync) ~~sync~~ baud.

Claims 1-3, 5-26, and 28-48 are renumbered respectively as claims 1-46, and the claim dependency is amended accordingly.

Allowable Subject Matter

3. Claims 1-3, 5-26, and 28-48 renumbered respectively as claims 1-46 are allowed.

4. The following is an examiner's statement of reasons for allowance:

Claims 1-3, 5-26, and 28-48 renumbered respectively as claims 1-46 are allowed because the prior art of record, patented, published, or filed in the United States before September 23 1999 (see declaration under 37 CFR §1.131 filed February 1, 2005), does not disclose or obviate the claimed subject matter wherein a timing synchronization, a fractional subcarrier offset, or a subcarrier rotation of a single OFDM symbol is determined from the single OFDM synchronization symbol. The prior art reference Schmidl (US 5732113) discloses the determination of an integer carrier offset

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by a single OFDM symbol, but does not disclose the determination of the integer carrier offset as well as a fractional carrier offset (col. 17, lines 50-55) from the single OFDM symbol. Further, the prior art references additionally cited below do not disclose attaining the various types of synchronization claimed via a single OFDM symbol as claimed.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The following prior art of record not relied upon above are cited to further show the state of the art with respect to OFDM synchronization.

U.S. Pat. No. 5946292 to Tsujishita et al.

U.S. Pat. No. 5970397 to Klank et al.

U.S. Pat. No. 5991289 to Huang et al.


U.S. Pat. No. 6219333 to Ahn.

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jason M. Perilla whose telephone number is (571) 272-3055. The examiner can normally be reached on M-F 8-5 EST.


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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Chin can be reached on (571) 272-3056. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


Jason M. Perilla
May 11, 2005

jmp


CHIEH M. FAN
PRIMARY EXAMINER